Examination of the Antikythera Mechanism

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Technical Report 340

April 1989
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Athens 1-7 December 1988

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As a result of the hospitality of the National Archaeological Museum, Athens, and of Dr Calligas, Curator of Bronzes, I was able to examine the fragments of the Antikythera Mechanism in December 1988.

On 1/12/88 I was able to give the fragments a general examination with a hand magnifying glass - a task that proved quite taxing to my eyesight. On 5-7/12/88 I was afforded use of the facilities of the Museum's bronze conservation workshop including a desk magnifier with internal illumination that proved most effective.

It quickly became apparent that many details of the mechanism, as now visible, are at variance with Price's descriptions. I am of the opinion that a detailed fact-by-fact reappraisal of Price's description and analysis may be warranted. But as a first step, and in view of the limited time available, a more eclectic approach has seemed appropriate.

No X-rays of the mechanism are in the possession of the Museum. Checking of gear tooth counts and similar details has, therefore, been impossible. However there is, in fact, very little of the mechanism that cannot be seen, at least in outline, by visual examination alone.

I am most grateful for the Museum's friendly hospitality without which the following results could not have been obtained. John Papadopoulos, of the Australian Archaeological Institute at Athens, has proved an invaluable ally and friend of a stranger in a strange land.

Current State of the Fragments

The photographs I had seen had not prepared me for the strikingly three-dimensional character of the fragments. Fragment A consists of several substantial flat plates, gears, etc. well separated by accretions up to 10mm thick. There are many gaps in the accretions: either a consequence of their mode of formation or a result of cleaning. In places, therefore, it is possible to see a considerable distance in between the plates. Much important information is revealed in this way, though the sighting angles are generally awkward and measurements can rarely be made. Although much simpler in structure, fragments B and C are generally similar in character.

In consequence of their long period underwater, the fragments have been subjected to severe corrosion. This corrosion has a characteristic and consistent nature for all the fragments. Understanding this corrosion has important bearing on the interpretation of observations.

The remains of the bronze plates and gears is almost white in colour but with a faint greenish tint. It appears to have the texture, and possibly the low strength, of fine chalk. Small particles come away from the bronze from time to time in consequence of even the most careful handling when examining the fragments. As some of the greenish tint is an artifact of the lacquer with which the fragments have been coated, the places from which the particles have been dislodged are left strikingly white by comparison. The number of these spots is mute testimony to the extremely fragile nature of the fragments.

A thin layer of dense corrosion has formed hard against the bronze surfaces. This ranges from a very dark green in colour to almost black. It appears similar to the patina
of old bronze. For convenience I refer to it simply as the patina whilst accepting that it might differ in significant ways from the patina on objects recovered by digging on land.

The patina is quite thin - I estimate typically 0.2mm except in a few places where it seems to have filled cavities up to about 1mm (e.g., between back dial rings). The patina appears quite hard and to come away from the bronze surface in relatively large flakes - perhaps 3-5mm in size. The mirror image of the back door inscriptions are on a large sheet of patina, just as if a mould had been made from the door plates.

In other cases the separation of the patina appears to have torn away the underlying bronze surface. Most regrettably, this seems to have occurred during the cleaning of the upper back dials (fragment B1). These give the appearance of having once been covered with dense inscriptions that seem now irretrivably lost. Some similar damage, fortunately much less severe, has also occurred to the lower back dials. Any future cleaning which involves the separation of the patina from the bronze will need to be done with great care.

Where the separation of plates is much more than about 1mm the cavity between the two adhering layers of patina has filled with unconsolidated accretion products. For convenience again, I refer to this simply as the accretion.

The accretion is rather gritty or modular in appearance - very easily distinguished from the patina. I imagine that the particles of the accretion generally adhere relatively loosely to one another. A few isolated fibers, fawnish in colour, are embedded in the accretion. For the most part, the accretion is dark in hue, brownish, greyish or blackish generally, though some is blue-greenish or reddish.

In some places the accretion appears much more densely consolidated and harder - the appearance of the traditional encrustation of long submerged objects. I suggest that this dense accretion marks surfaces, such as the front of fragment A, that have long been directly exposed to the sea rather than partially protected in some internal recess of the object.

The left third of the back of fragment A has light accretion of a distinctively cream hue, especially where the remainder of the differential would have been. As the broken edge of the differential and its attached gears is uncorroded the break must be relatively recent. Possibly the left portion of the differential was lost during, or shortly after, recovery from the wreck.

**Arrangement of the Fragments**

I was most delighted to discover the fit of fragment D to the right of the differential in just the area where I had suggested the drive to the entire mechanism, by a synodical month gear train, should be.

Fragment D fits against the larger differential wheel E4 a little above center. It is constrained above by the lower riveted piece shown in Price’s drawing (figure 14). Lower down, fragment D lies over E4 and comes almost up to the smaller differential gear ring, E3. At the right, fragment D nestles in amongst the corrosion products adjacent to the wooden side frame (no longer extant at this point). The differential fits at
the bottom of fragment D in Price's figures 20a and 20b. Figure 20b shows the surface adjacent to the base plates.

In view of the corrosion of the fragments the fit is excellent. When in position, fragment D has no perceptible movement in the plane of the baseplates. It is, however, free to rock. This seems to be a consequence of the cleaning of accretion from the base plates under the upper part of fragment D. (Compare the upper left of Price's figures 16 and 15.)

I concur with Price's fit for fragment B over the upper right of the back of fragment A and therefore, for the most part, covering fragment D.

I cannot agree with Price's fit of fragment C over the lower left of the front of fragment A. I think the fit is better over the upper right. An edge of fragment C then seems to follow generally the contour of the highest part of the contrate wheel and the adjacent attachments to the large gear wheel B1. It also brings the paraperga inscription into the same upright orientation as all of the inscriptions on the back of fragment A.

The only significant part of the mechanism that seems to have been lost, during or since recovery from the wreck, is the left hand half of the differential. Possibly some parts of the dial and cover plates have also been lost. The other parts of the mechanism appear to have been separated from the remaining fragments long before recovery from the wreck, though possibly long after the original sinking.

If this conjecture is true, then about two thirds of the large wheel B1 should have been visible, in a condition not too different from Price's figure 13, when the object was first recovered. That raises again the question of why the object did not attract attention sooner after recovery. The answer may be no more profound than the extreme busyness of all concerned in the recovery operation.

Materials used for Plates and Gears

Whilst I can agree with Price that the base plates are each about 2mm thick, or nearly 4mm in total, I believe that the other gears and plates were much thinner. I estimate them to be generally about 1mm thick or just a little more - probably not so much as 1.2mm.

I can only imagine that Price made his measurements to include the patina. However, in many places this has flaked away, or been cleaned away, to leave a definite surface to the bronze below. In other places, notably the gear trains of the differential, Price has failed to recognise so many distinct layers of bronze as I see to be present.

I distrust the high putative accuracy of many of Price's measurements that are quoted generally to 0.1mm. Except in the case of compact and well defined features I have not felt measurements to better than ¼mm to be justified, and frequently 1mm has seemed all the accuracy that was warranted.

The Differential

In Price's reconstruction the differential is the heart of the entire Antikythera Mechanism. It is the critical element in the embodiment of the Metonic cycle - the fact
that 19 tropical years is very nearly equal to 254 sidereal months or 235 synodical months - which was the basis of many ancient calendars.

Whilst I concur with Price respecting the general arrangement of the gear trains, except the drive mechanism that I have discussed in a previous paper, my observations suggest that many of the details are different.

The main gear E4 of the differential, which forms the base plate on which the auxiliary gearing is carried, and the ring gear E3 follow Price’s descriptions. However, I see them both as much thinner - 1.0-1.2mm only.

The arrangement of the auxiliary gearing carried on the differential is quite clear as the entire mechanism has been sectioned by the break that has removed the left half of the differential.

Axis K carries two gears and a small disc, about 8mm diameter, above the differential plate. There is nothing in this position under the differential. The upper gear is the larger. The gear adjacent to the differential plate is just minimally smaller so that its tooth tips are within the circle of the roots of the teeth of the upper gear. I can readily accept Karakalos’ counts of 51 and 48 teeth respectively for the two gears.

I suppose that the two gears are secured to one another but rotate freely on the (fixed) axis. I imagine that the disc, fixed to the axis, retains the gears in position. The two gears play the roles of Price’s K2 and K1 respectively.

At the center of the differential, on axis E, there are again two gears above the differential plate. These are similar to K2 and K1, though the corrosion makes them more difficult to distinguish. I take these as equivalent to Price’s E5 and E2ii. The tooth counts should match K2 and K1: 51 teeth for E5, consistent with Karakalos’ count of 50-52; and 48 teeth for E2ii, but I have no evidence for this other than the size of the gear.

E5 is secured to its shaft - there is clear evidence of a squared fitting. There is thus no need for a retaining disc. However, E5 carries a short segment, about a 60° arc, of a ring about 2mm thick. I take this as the remains of a spacer ring to support the back dial plate; or at least persuade it to keep its distance. The dial plate, at this point, is thin and narrow.

In reconstructing the mechanism I must suppose that E2ii is joined by a hollow tube or pipe to a gear E2i below the differential. The pipe must turn freely on the axis E; and the differential must turn freely on the outside of the pipe. However, from its position under E5, there is no direct evidence for such a pipe.

Overlying the area where E5 and K2 mesh are small fragments of a plate. Rather uncertainly I think I see a fit of these as extensions of the upper dial rings of fragment B.

The final element of the differential gear train would be a gear, J, engaging both E2ii and K1. This gear must lie above but close against the differential plate. It must therefore have been on the left of axes E and K on the part of the differential now missing. I imagine this gear J turning freely on a fixed axis but retained in position by a disc similar to that over K2. The number of teeth is immaterial, but in the absence of any
evidence we might guess 48 teeth to match E2ii and K1.

I cannot imagine the purpose of the rectangular plate, square pillar, and cross pin on the differential turntable to the right of axes E and K. Price took this to be the axis J, but the arrangement is quite inappropriate for supporting a gear above but adjacent to the differential plate.

No part of the gear train carried by the differential projects below the differential plate. This is consistent with the observation that the 127 tooth gear D2 is flush against the underside of the differential plate. Any projection would cause interference.

No mathematical relationship dictates the choice of 51 and 48 teeth for the differential gear train. Other numbers, such as 48 and 45 would suffice. The choice of 51 argues against my supposition that a dividing plate was used for all gears not dictated by the underlying astronomical ratios.

The Differential Drive Train - Fragment D

The drive gear, heavily encrusted within fragment D, I will call P. It is a gear of 64 teeth as seems quite clear from the X-ray, Price's figure 28. The gear P is unusually thick, about 1¾mm, and appears to have larger diameter but much thinner (¾mm) plates riveted above and below by three rivets. I imagine these were guard plates that embraced the main differential gear E4 to guarantee correct meshing with P.

The axis of gear P, discernable on both the upper and lower surfaces of fragment D, appears to be a tube about 7mm outside diameter and 4-5mm bore. There is no corresponding bearing hole in the main plates. But there are three rivet holes to the upper right of the differential that may indicate some support structure.

Two short bars, possibly originally one longer bar, cross the gear P in a direction roughly from 11 o'clock to 5 o'clock.

The encrustation of the upper right of fragment D suggests that some further circular component may be contained therein. There is no other direct evidence for the rest of the drive train.

The Synodical Gear Train

The synodical gear train, to the lower back dial and the auxiliary dial of twelve lunar months, follows Price's description in general outline. I have not examined this train in detail except to note that the gears F, G, H, and I are only about 1mm thick as are the other gears throughout the mechanism.

There are retaining discs on the front of the base plates for the axes F, G, and H. This suggests that the gears are fixed to the shafts but that the shafts rotate freely in the supporting blocks. Price's drawing, figure 11, suggests a similar retaining disc on axis I but it is no longer extant. If such a disc was originally present, as seems plausible, it has been removed during the cleaning. Similarly, I see no sign of the square shown in Price's drawing on axis G.

I do not understand the purpose of the two bars on the front of the base plates between axes G and I.
The Metonic Gear Trains

The arrangement of the gearing in the narrow space between the main base plates and the differential are not easily seen.

The differential plate, the gear E4, is itself bent. At the bottom and in the center it lies about 3mm above the base plates - leaving ample room for two or possibly three layers of gearing. At the top the differential is bent to within about 1mm of the base plates. It rests, in fact, on the remains of gear M2 or the plate immediately adjacent to M2.

The arrangements under the center of the differential, on axis E, are obscured by corrosion products. I see a gear wheel close against the base plates; a layer of accretions; and, fairly confidently but not clearly, another gear close against the underside of the differential.

On the front of the base plates it is quite clear that there is no gear on axis E. Rather there is just a plain disc, quite clearly defined, that I presume to be a retaining disc.

I have therefore identified the gear under the differential adjacent to the base plates as Price's gear E1, and the other adjacent to the differential as Price's E2i. As mentioned earlier, gears E2i and E2ii must therefore be carried on a tube passing through the differential, but this would be obscured by other parts of the mechanism, particularly the gear E5, and cannot be seen. The axis E must pass freely through this tube and carry gears E1 and E5. The axis E I suppose to be retained in position by the disc on the front side of the base plates and the gear E5. E5 also serves to retain the entire differential mechanism in position.

The large 127 tooth gear D2 is quite conspicuous under the differential and is certainly close against the differential plate. Price's X-rays, figures 22 and 23, show a ring which could serve to support D2 above the base plates.

There are other bronze components, including gear teeth, visible amongst the accretions between the base plates and the differential. These must be the gears on axis B, but I have been unable as yet to discern any details of the arrangements. Note that as Price's gear E1 is on the back of the base plates under the differential it follows that both of Price's gears B3 and B4 must also lie in the space under the differential.

My observations that D2 and E2i both lie close against the underside of the differential raise again the problem of D2, B4 and E2i intermeshing and locking up the whole gear train. This difficulty, which Percival and I encountered when building our first reconstruction of the Antikythera Mechanism, could be resolved by doubling the thickness of gear B4 and offsetting gears D2 and E2i out of the same plane. But that approach seems no longer acceptable unless E2i is not as I observe (admittedly somewhat uncertainly) close against the underside of the differential. If such a difficulty had arisen in the original construction of the Antikythera Mechanism it could have been resolved far more simply by offsetting further the line of the axes C and D. However, the difficulty seems to be perfectly real in Price's X-ray figure 23. I think I am definitely missing something here.
On the front of the base plates gear D2 is not well preserved, but the arrangement of this and its flanking support blocks is evident from the X-rays and I concur with Price’s interpretation. D2 appears to be close against the base plates.

Gear C2 is close against the base plate and C1 is immediately above it. However, gear C1 appears to be a ring with a fairly large 5-6mm diameter hole in its center. I suppose that gears C1 and C2 turned together loose on a fixed shaft C, and were retained in position by a disc which occupied the hole in C1. With this arrangement the retaining disc would not be so high above the base plates as to foul the arms of the large front gear B1.

Gear B2 is quite clear immediately below the large gear B1. There is a space, filled with accretions, between B2 and the base plates. I imagine there was a spacing ring in this space.

The ‘Four Year’ Gear Train

The pair of gears L1 and L2 appear to be as described by Price. Possibly these were mounted in the same manner as C1 and C2 - turning together loose on a fixed shaft and retained by a disc recessed into the upper, smaller, gear L1.

The large gear M1 is quite evident well below the level of B1 and probably close against the base plates. M2, on the back of the base plates, is very difficult to resolve visually, but I accept Price’s interpretation of his X-ray evidence (figures 21, 22, and 23).

As I have now found the fit of fragment D at the right of the differential we no longer have any evidence for the gear N or the continuation of the "four year" gear train, or of a gear at the center of the upper back dials.

Price’s X-ray, figure 21, shows a disc to the left of and a little below axis B at a place where it appears inside but roughly tangent with the outer edge of the differential. I do not know what this represents.

The Upper Back Dials

Price’s photographs, figures 17b and 17a, show that much accretion has been removed to expose the upper back dials preserved in fragment B. These dials give the impression of having been heavily inscribed, but nothing but a few characters, and those most uncertainly, can be read by my untutored eye.

My initial impression was that the inscriptions would be revealed by further cleaning. That was Price’s impression also. Now, however, I believe that the cleaning has already removed the surface of the bronze plates and the inscriptions are probably irretrievably lost. It is possible my interpretation is in error as the present colour of the dials is much darker than that usual for corroded bronze, which is quite clearly seen on the inside of these dials, and that a layer of patina remains to be removed.

The general arrangement of the upper back dials, as a set of nested rings, follows Price’s descriptions.

I see faintly, but certainly, seven sets of radial division lines crossing all three visible dial rings and, possibly, the surviving section of dial limb. By measurement and
calculation I conclude that there were 48-50 divisions in the complete dial. But the measurements are difficult to make and the conclusion somewhat uncertain. The observations are compatible with the supposition that the dials represent a four year calendrical system with monthly divisions, but are not so strong as to mandate such an interpretation. Certainly the observations are not compatible with my previous suggestion, that the upper back dial represented a Saros cycle of eclipses over 223 lunications, without major adjustment of my ideas.

The center of the upper back dial is a very confused jumble of corrosion products for which I do not as yet have an interpretation. The pointer bar, in about the six o'clock position, is quite clear but lies about 5mm above the dial plate.

Inside the dial plate I see evidence of a bronze component, possibly part of a gear, close against the dial plate. Outlined in dense corrosion products I see evidence of part of a square similar to the outline of a square visible in the jumble of corrosion products outside the dial plate.

The subsidiary dial is visible only with difficulty under the layer of accretion products. Only a segment of the circle, 120°–150° in extent, can be seen along with two radial lines. The center is obscured by accretions. I see the angle between the radial lines as substantially less than 90°. They suggest that the subsidiary dial is divided into five rather than Price's four. I cannot see Price's inscribed letter Σ - indeed there are accretions in the place where he claimed to see it. Rather I read, somewhat uncertainly, a letter Δ in the visible segment, which is the upper left.

On the inside of the dial plate, on the axis of the subsidiary dial, is the prominent feature described by Price. There is a thick layer of accretions under the dial plate which could well contain a small gear as Price's X-rays suggested to him. On top of the accretions is a gear about 13mm radius which Price gives as 48 teeth though the size suggests about 54. Immediately above the gear is a bronze component which appears to be a disc 2-3mm thick somewhat broken away. Beyond the disc projects a small thin ring of patina which I suppose once surrounded the axis.

I believe that the thick "disc" may be a fragment of the base plates. If so, the gear originally lay close against the base plates. The dial plate would then here be about 8mm above the base plates. This measurement is compatible with the center of the lower back dial which I measure as being 9mm above the base plates. About 8mm is necessary to accommodate the many layers of gearing of the differential and metonic trains or of the synodical mouth trains.

The Lower Back Dials

My observations of the lower back dials accords generally with Price's. Much accretion has been removed to expose the dials whose surface layer appears, in places, also to have been removed.

The subsidiary dial is outlined in three well separated places. There can be no uncertainty as to its general circular form. Part of the subsidiary dial has broken away with the dial plate and the greater part is covered with accretion. It is possible that
remains of a pointer lie within these accretions. There is no evidence visible of radial division lines.

The bridge joining the dial rings can only be seen by peeking awkwardly between the base plates and the dial plate. The bridge consists of a series of semi-circular "arches" standing one across each dial ring and each pierced with a small square hole adjacent to the dial ring. The whole arrangement seems as unintelligible as it is attractive.

The Front Gears

The large front gear, B1, and the contrate gear, A, with which it meshes are amongst the most prominent features of the remaining fragments of the Antikythera Mechanism. Unfortunately, this side of the mechanism appears to have been long exposed directly to the sea and is therefore heavily encrusted so that details are not easy to discern. The visibility of detail has been greatly improved by the extensive cleaning that has taken place.

The contrate gear, A, is largely as described by Price. The most striking feature is the large rectangular hole, about 6mm x 9mm, in the center of the gear. This suggests a fitment that is very substantial in proportion to the general character of the Antikythera Mechanism.

The "supporting pillars" which Price believed provided a bearing for the contrate gear are part of the large gear wheel B1 and bear only an accidental association with the contrate gear A. I see the contrate gear as being supported by a saddle that seats onto the base plates. At present the saddle spans only about 90° of the periphery of the contrate gear, but there are accretions at either end which suggest that the saddle might originally have encircled the contrate and provided a full bearing for it.

The large front gear, B1, is generally as described by Price. The pillar immediately above the contrate is an L shaped piece attached to the rim of B1. The foot appears to be perhaps 7mm wide and 10-12mm long, but possibly much less as it is difficult to judge the thickness of the accretions. The leg, a rectangular column, rises about 27mm above the gear where it is broken off at an angle. The top of the leg is about level with the top of the core part of the contrate gear.

This pillar is attached to the rim of the gear B1 midway between two spokes in about the three o'clock position. In the 12 o'clock position there is a rivet and the clear imprint in the corrosion of a rectangular foot. In the same position in the other two quadrants, at six o'clock and nine o'clock, there are indications of rivets. I conclude that there were originally four similar pillars that supported a large wheel, gear, or dial ring, at or above the level of the top of the contrate gear.

Two further pillars rise from the rim of the gear B1 between the contrate gear and the spoke in the four o'clock position. I do not understand the purpose of these.
The Front Dial Fragment

The front dial fragment, fragment C, consists of segments of the two front dial rings, a corner of the surrounding dial plate, portion of the overlying parapegma plate, and the cylindrical structure that Price considered might be a handle. I will call this last the "drum" as I find the title "handle" too suggestive and possibly misleading.

Price considered that this fragment overlay the lower left of the front gear, B1. I prefer a fit over the upper right. This brings the parapegma inscription into an "upright" orientation, and I think I see some measure of fit around the conrate gear. Possibly, before cleaning, there was some further evidence for Price's fit. As our understanding of the mechanism stands at present there is really nothing of consequence to choose between the two.

The front dial fragment has suffered definite distortion. The front plate and the parapegma plate are both bent up, through about 20°, about a line roughly tangential to the outer edge of the dials. Both then bend down again, through a somewhat steeper angle nearer 30°–40°, towards the corner of the front plate.

I believe this distortion may have occurred long after the original sinking. The front dial plate and the parapegma plate remain equidistant from one another throughout the bends, and the bends are marked by clear and substantial cracks on the inside of the front dial plate. This could have occurred if an object had lain against the corner whose weight caused the distortion as the bronze plates weakened from corrosion. The plate might have cracked in bending in consequence of the same corrosion. An established layer of accretions could have maintained the separation of the front dial plate and the parapegma plate.

It is possible that, in consequence of the distorting forces, the drum is now displaced in the direction of the corner of the front dial plate away from its original position.

In the very corner of the dial plate I believe I see a rivet. Further down the side edge is a square hole which seems to be a focus of one of the bending cracks rather than an accidental result of corrosion and distortion. It might represent a fixing of the front dial plate to a wooden side piece.

The "peg" that Price saw near the corner of the front dial plate I see as a bar, riveted to the dial plate near its end, and covered by a narrow band near the upper edge of the plate. Possibly it joined the dial plate to a further plate abutting its edge.

The Front Dial Rings

The arrangement of the front dial rings is much more complex than Price describes, though it took me some time to notice this fact.

The two front dial rings are each 7mm wide and fit close against one another and the dial plate. There is no possibility of holes between the dial rings for a parapegma - and no need either if a hand moves over the dial to indicate the tropical year. I read only Price's A, Ω, Δ, and E of the parapegma. I cannot identify his Ω or B.
On both dial rings there is faint but unmistakable evidence of a scribed circle. The
dial divisions appears to have been engraved inwards starting from this scribed circle. It
is impressive that the dial rings have survived in good enough condition for this evidence
to be discernible.

A band of thirty consecutive divisions all equal to one another, within a month or a
zodiac sign, are not easy to read. I am surprised to see no evidence for some intermediate
degree of subdivision such as decans. Possibly this confirms that the entire mechanism
was intended for a display rather than a serious scientific purpose.

The ring visible on the back of fragment C is 9mm wide and appears to overlap the
dial plate about 5mm and the outer calendar dial ring by about 4mm. This back ring
might form a circular recess in which the calendar ring could turn. Adjacent to the drum
is evidence either of a pair of rivets fixing the back ring to the dial plate, or of the end of
a mortice and tenon joint. The "holes" shown in Price's X-ray, figure 27, appear coincident with the inner edge of the back ring and fall roughly in the middle of the outer
calendar dial ring. The "holes" are more likely gear teeth. I suggest we have here either
internal gear teeth on the back ring or the impression of gear teeth left in corrosion
products by a large gear wheel.

There appears to be another ring riveted to the inside of the inner zodiac dial ring.
This is very poorly preserved. It could possibly be a fragment of the rim of a large gear
like B1. Alternatively this could be part of a center plate for the front dials of which we
have otherwise no evidence. I find this latter improbable as there appears to be no
evidence of such a centerplate between the drum and the para pegma.

Price's fiduciial mark near the outer dial ring is certainly now a crack. I have not
been able to persuade myself that it was originally a deliberate engraving mark from
which a crack subsequently developed.

Near the end of the remaining segments of the dial rings, adhering to their inside, is
a peculiar collection of corrosion products about 25mm long and 5mm high. Although
no definite bronze core seems to remain the corrosion products are very distinctly layered
and in a similar manner when viewed from either end. It suggests a rim standing
perpendicular to the inner edge of the outer calendar dial ring with a secondary step over
the inner edge of the back ring. Alternatively it could represent a clip that rises from the
dial ring, folds through 180°, and finally turns out over the back ring. Price's row of
"holes", which I interpret as the impression of gear teeth, appears to continue through this
area of corrosion.

I have not been able to interpret the drum adhering to the inside of the dial
fragments. I am unable to accept Price's conjecture that this is a driving handle for I
have not been able to find a convincing rationale by which a driving handle could come
to be in this position apparently entangled with whatever mechanism was carried by the
large gear B1.

If, however, the original position of the drum were about 5mm nearer the center of
the dials its rim would come tangent to the inner edge of the outer calendar dial ring and
hence tangent to the rim or clip attached to that ring and described above. Such an
arrangement would be suggestive of a driving or driven connection between the two. But the idea is purely speculative.

The outer diameter of the drum, 62-63mm, is almost exactly equal to the inner radius of the inner zodiac dial ring. This again is suggestive of some functional relationship between the two. But again the idea is purely speculative.

Postscript

In the foregoing pages there are many places in which it might seem that I am critical of, or in disagreement with, the work of Derek de Solla Price. At the level of detailed observations that is certainly true.

It is equally true that with regard to the broad organisation and function of the Antikythera Mechanism I am in complete agreement with Price. I regard Price’s work as an excellent piece of deductive scholarship.

But it is inevitable that a fresh mind taking a fresh look at the object from a fresh perspective should reach some different conclusions. The most valuable experience I have brought to the examination of the object is the attempt to make a reconstruction with my valued friend and colleague Frank Percival. That experience has framed many of my questions and shaped many of my answers. But none of this would have been possible without building on the prior work of Derek de Solla Price.